PREDICTING CHANGES IN THE BEHAVIOR OF ERUPTING VOLCANOES, AND REDUCING THE UNCERTAINTIES ASSOCIATED WITH THEIR IMPACT ON SOCIETY AND THE ENVIRONMENT

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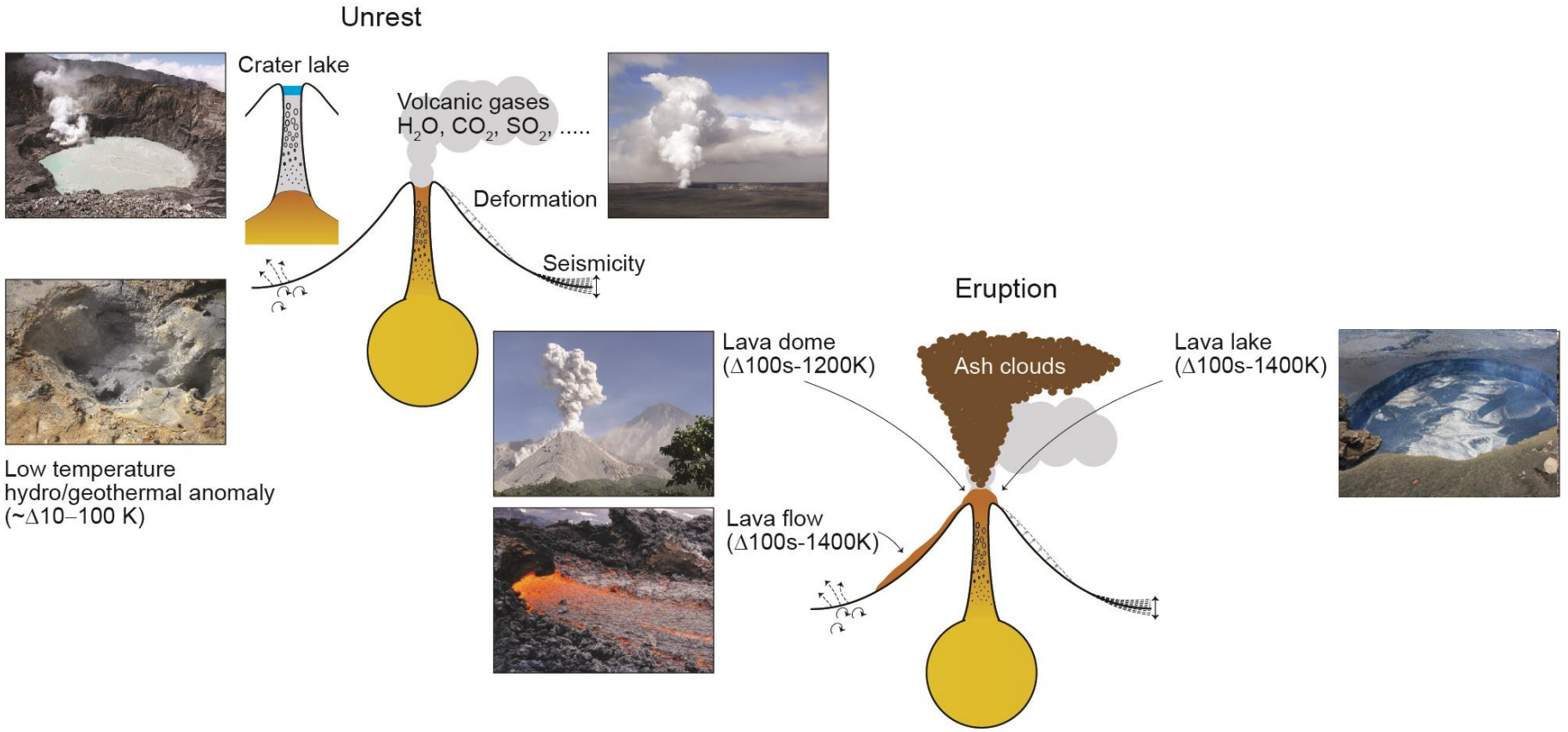


What happens before, during, and after a volcanic eruption, which of these processes can we measure from space, and of these which will we be able to quantify better using HyspIRI?

Crater lake

Volcanic gases
H_2O, CO_2, SO_2, ...

Deformation

Seismicity

Low temperature
hydro/geothermal anomaly
(~Δ10–100 K)

Unrest

Lava dome
(Δ100s-1200K)

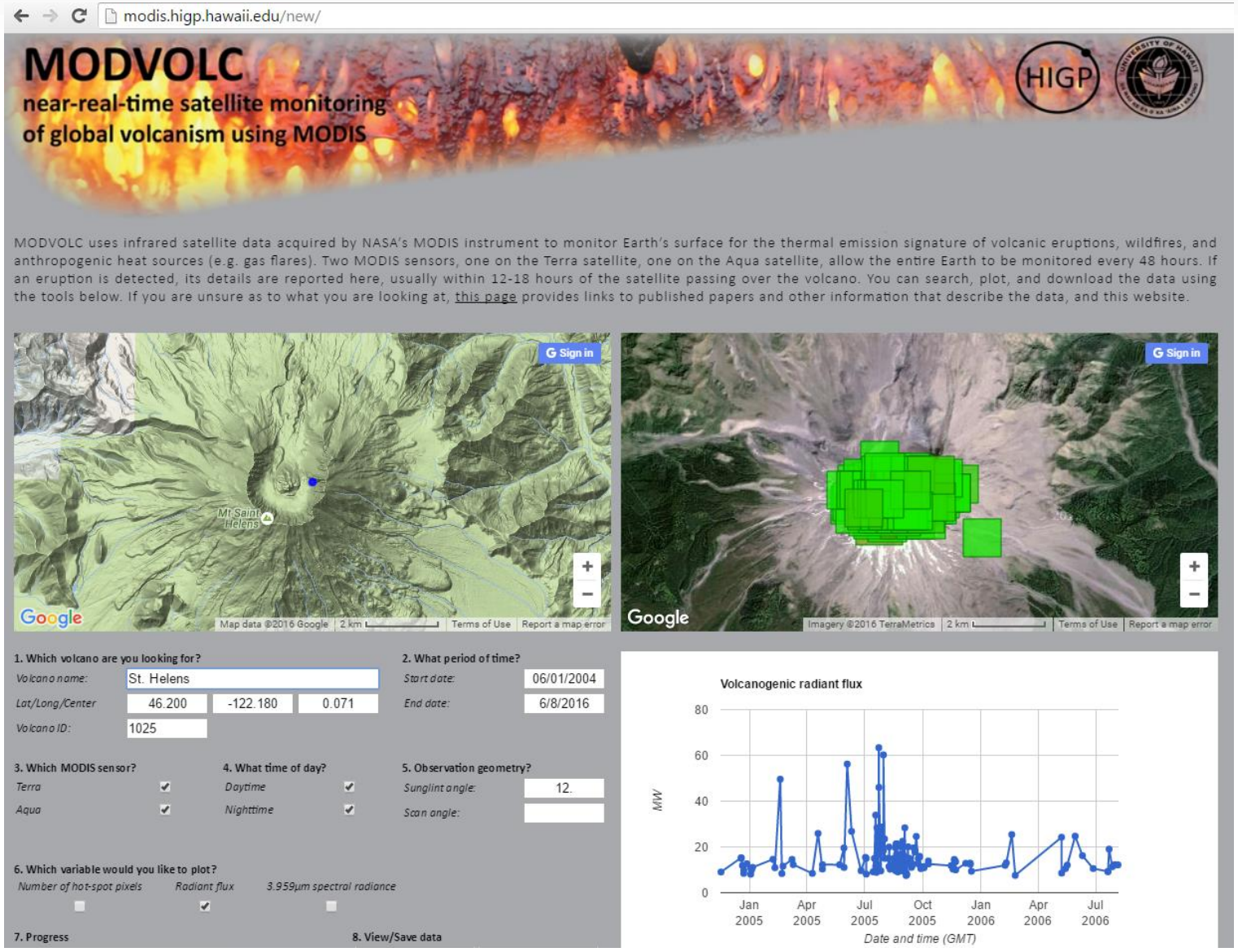
Lava flow
(Δ100s-1400K)

Ash clouds

Eruption

Lava lake
(Δ100s-1400K)

When and where do eruptions take place? How intense are they? Are there resolvable changes in physical characteristics prior to eruptions?

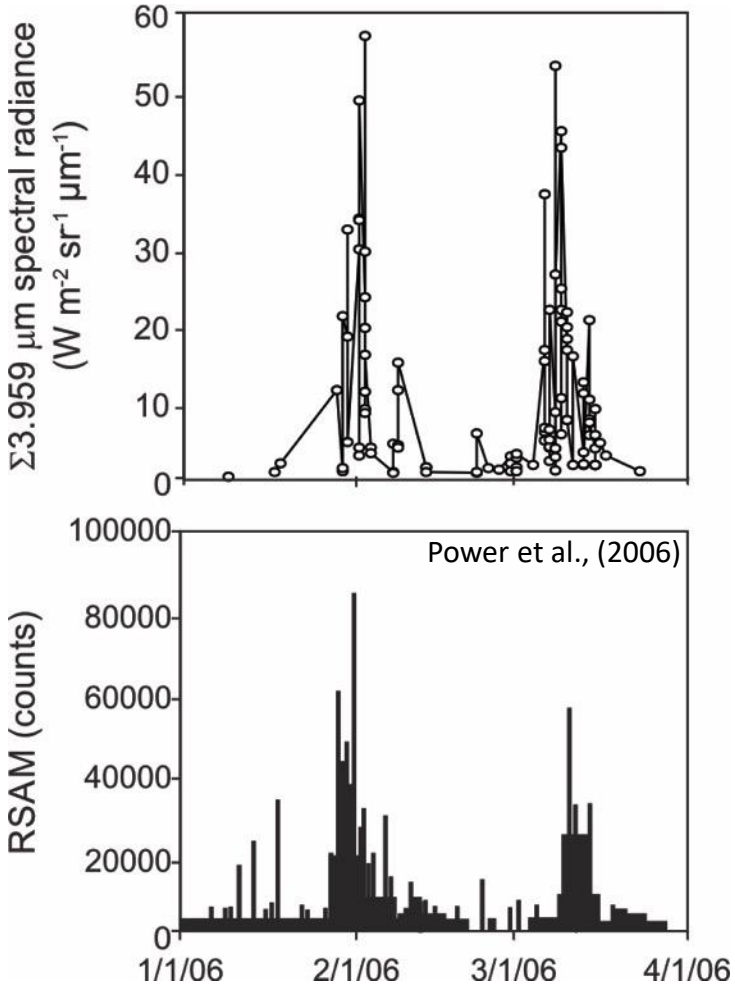


- Of 441 volcanoes in 16 developing countries 384 have little or no monitoring, including 65 volcanoes identified as posing a high risk to large populations[1]
- 500 million people living within the potential exposure range of an active volcano[2]
- Volcanoes are poorly monitored. HyspIRI will provide an hitherto unavailable capability to monitor global volcanism at high spatial *and* high temporal resolution

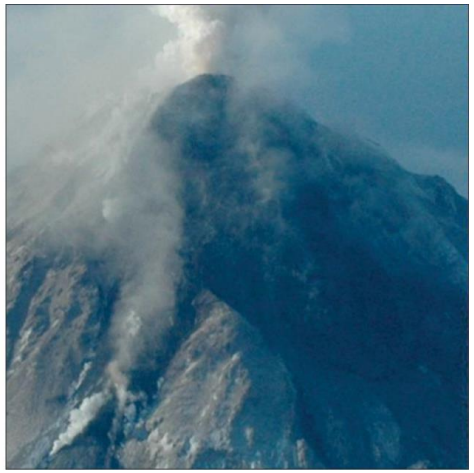
1. Aspinall, W. et al., (2011)
2. Doocy, S. et al., (2013)

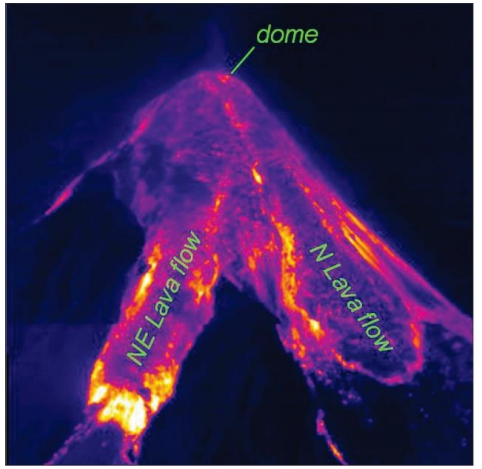
IMPORTANTLY, SATELLITE MEASUREMENTS OF EMITTED SPECTRAL RADIANCE ACT AS AN EFFECTIVE PROXY FOR ERUPTION INTENSITY

2006 eruption of Mount Augustine, Alaska

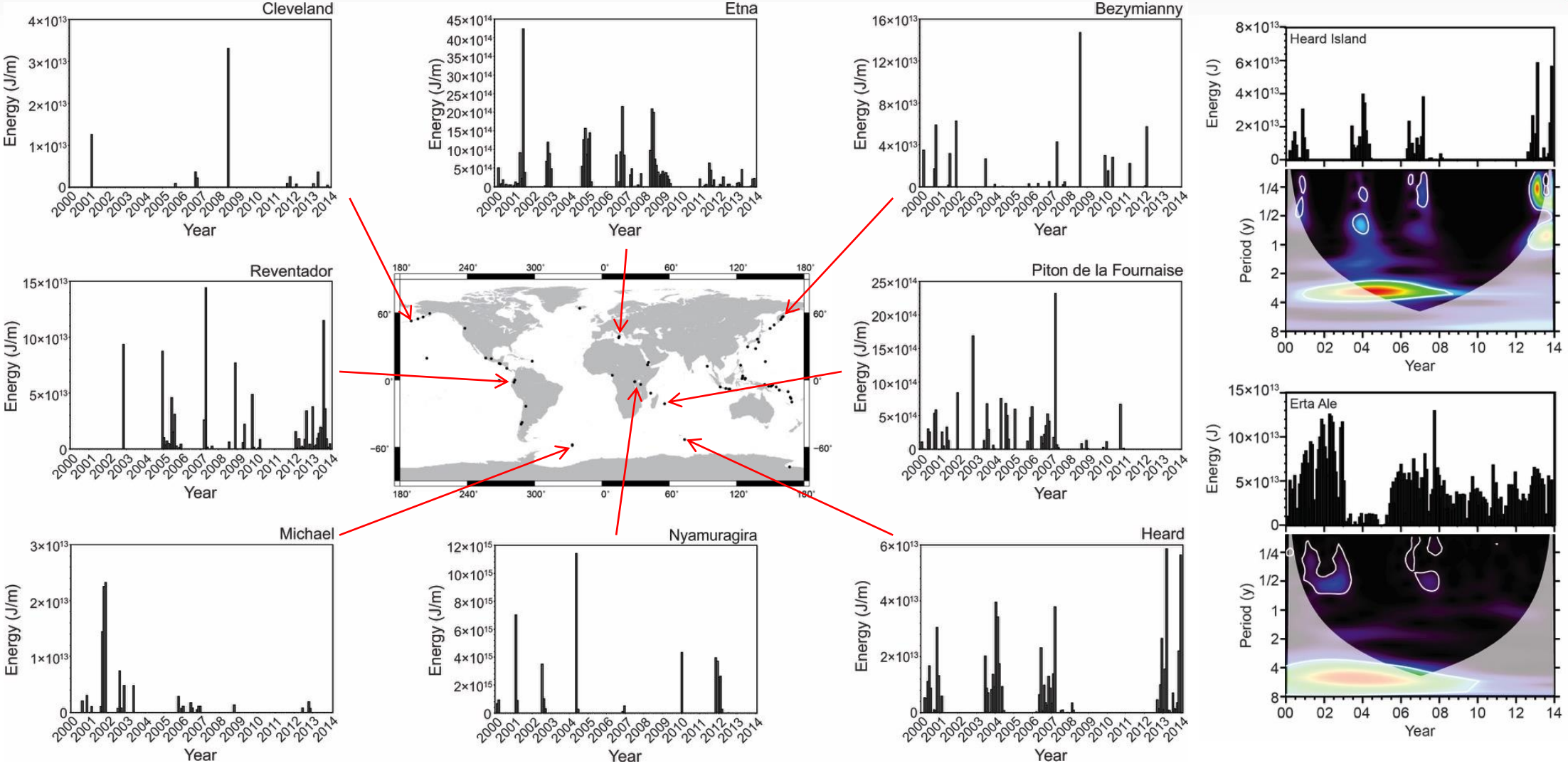


Source: AVO/USGS





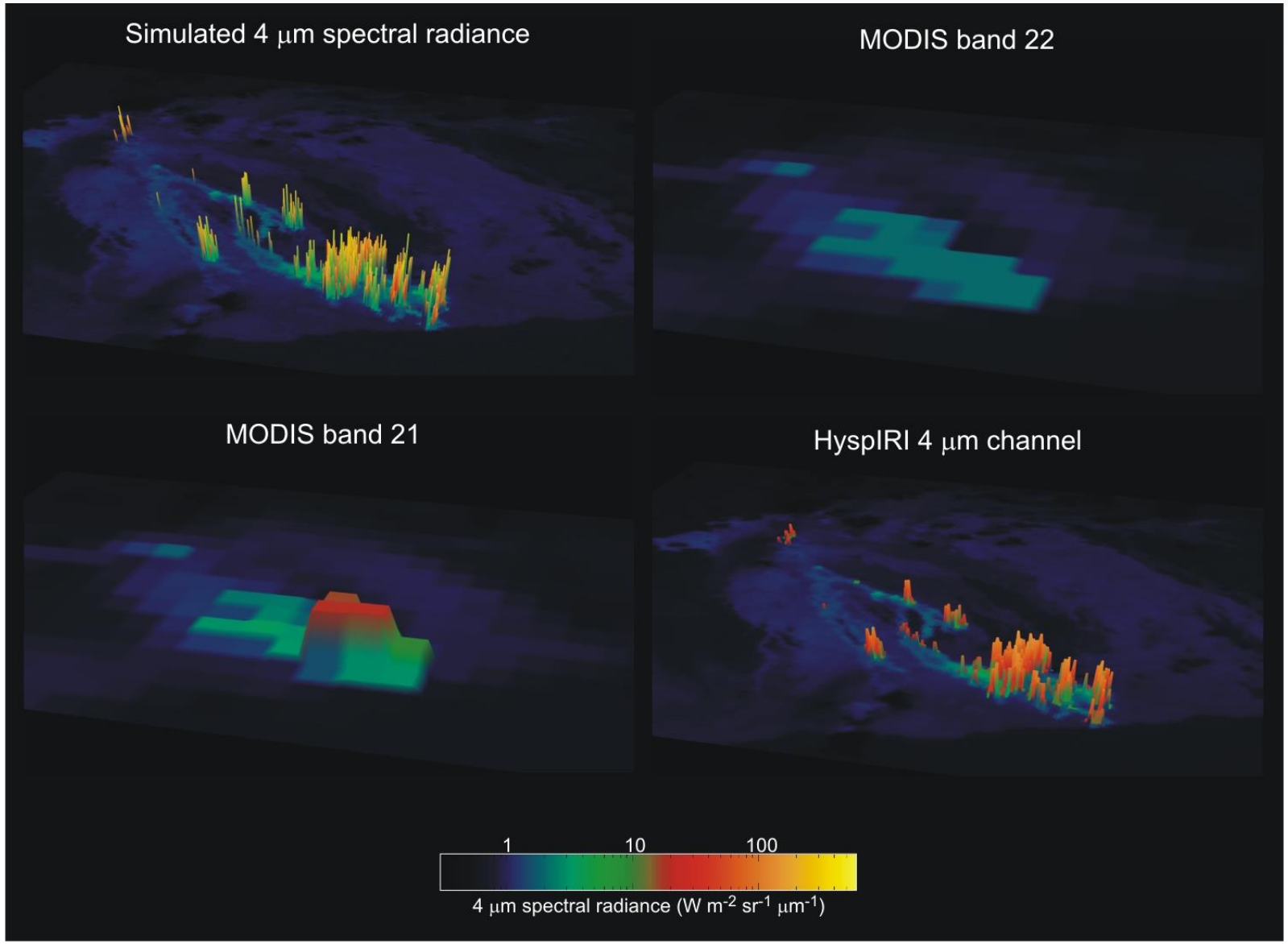
SATELLITE REMOTE SENSING YIELDS A RECORD OF VOLCANIC THERMAL UNREST OF UNIFORM QUALITY, AND WITH HIGH TEMPORAL FREQUENCY AT THE GLOBAL SCALE



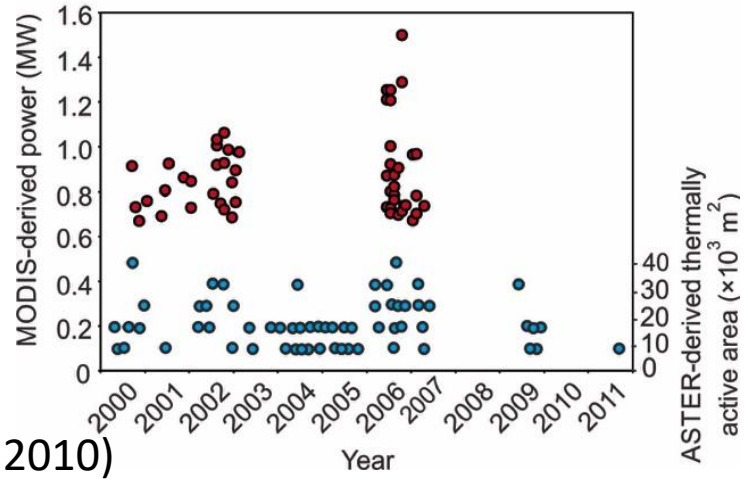
What levels of emission are characteristic of a particular eruption style? Are there temporal patterns in thermal emission?

Wright et al., (2014)

HYSPIRI'S HIGH SPATIAL *AND* TEMPORAL RESOLUTION MEASUREMENT CAPABILITY WILL FILL A LONG-STANDING MEASUREMENT GAP

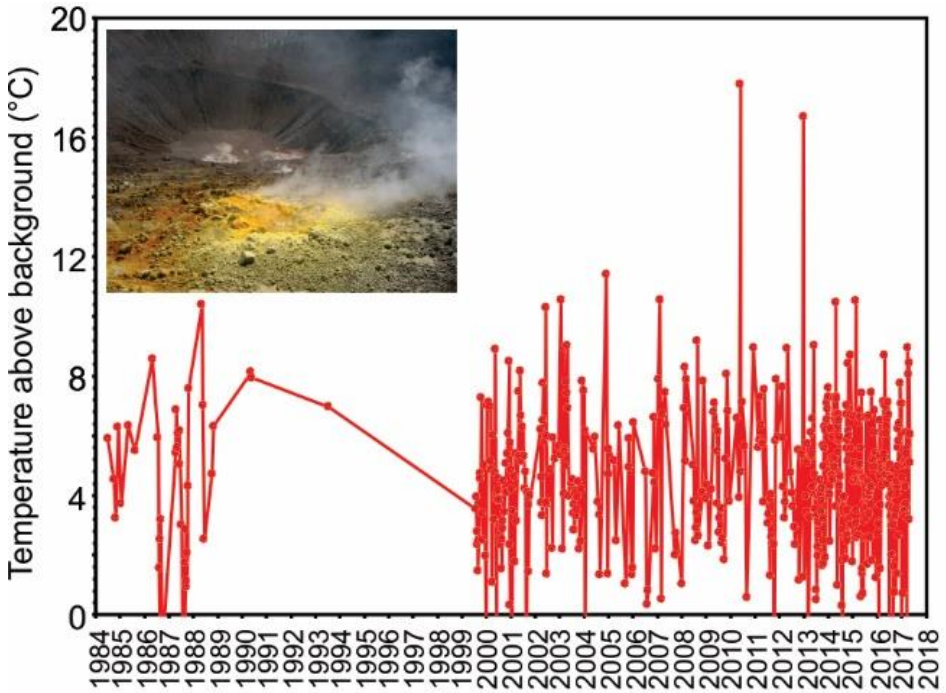


GLOBAL VOLCANO MONITORING SYSTEMS BASED ON LOW SPATIAL RESOLUTION DATA LACK SENSITIVITY. HYSPIRI WILL BE ABLE TO DETECT LOW INTENSITY THERMAL ANOMALIES AT AN EARLIER STAGE IN THE ERUPTIVE CYCLE

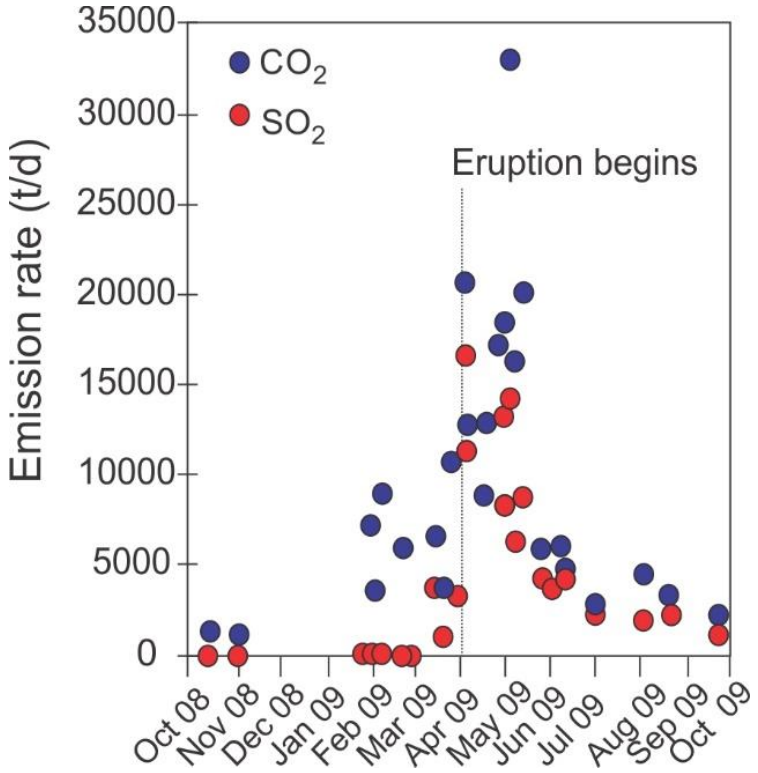


Murphy et al. (2010)

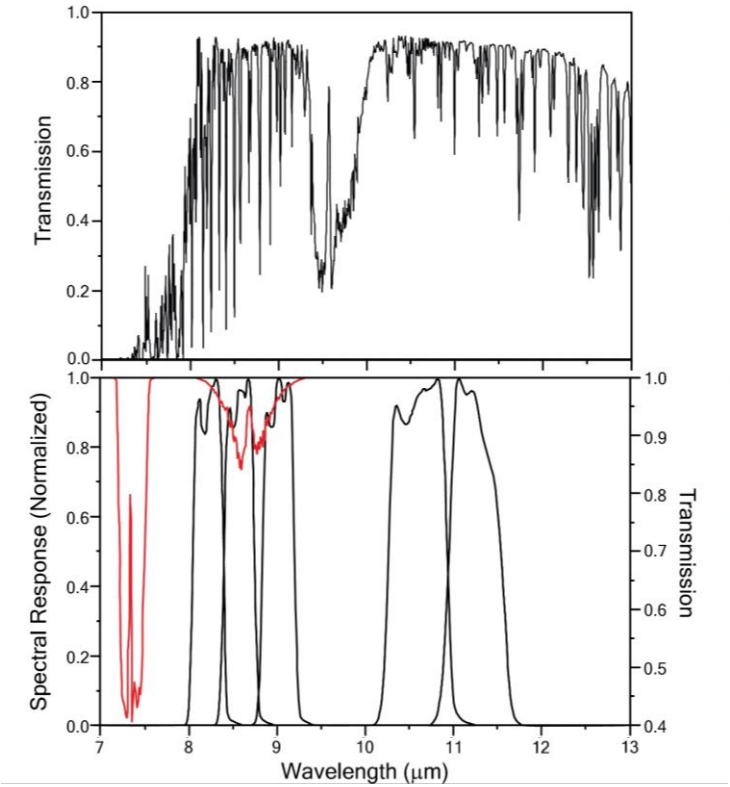
Thermal emission from the summit of Vulcano as measured by Landsat TM/ETM+/TIRS

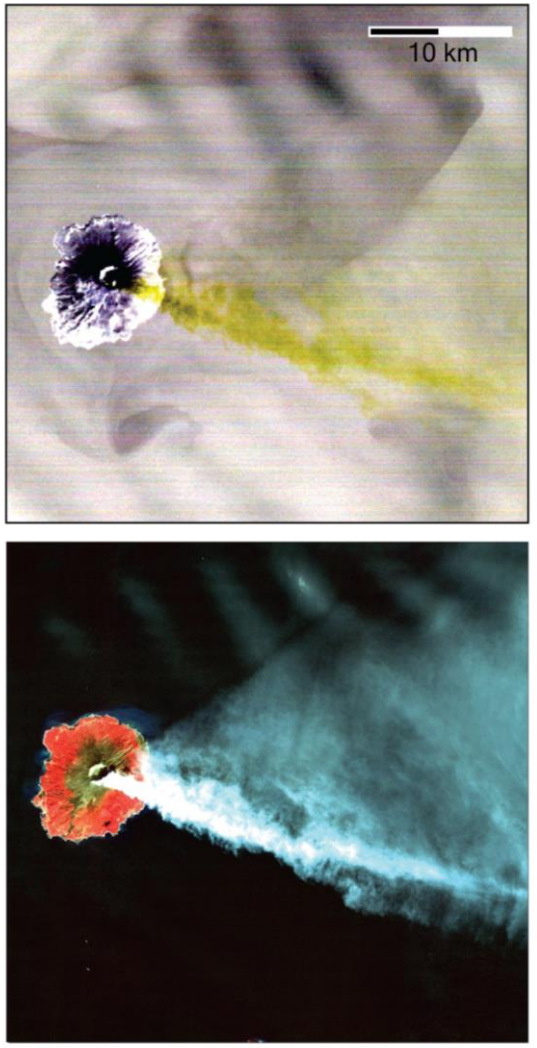


MAGMA CANNOT RISE WITHOUT RELEASING GASES – WHICH HYSPIRI WILL BE ABLE TO MEASURE WITH AN UNPRECEDENTED TEMPORAL FREQUENCY AND PRECISION

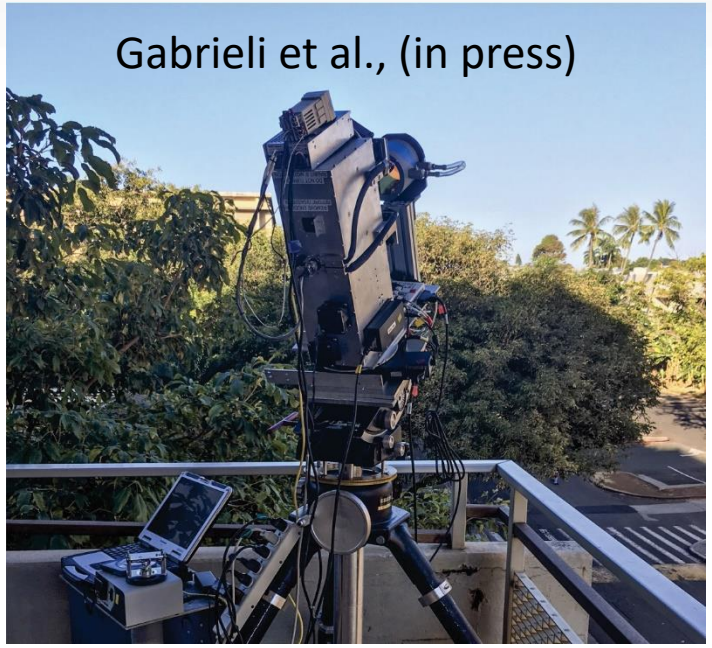


CO_2 and SO_2 emissions increased prior to the 2009 Eruption of Augustine (Werner et al., 2012)

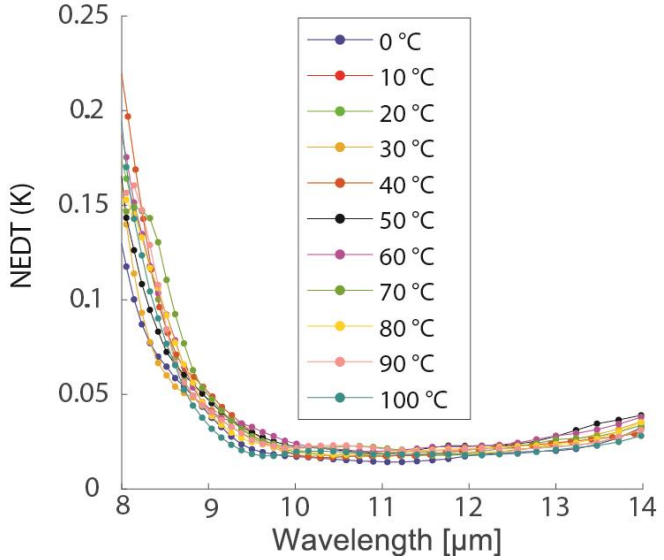


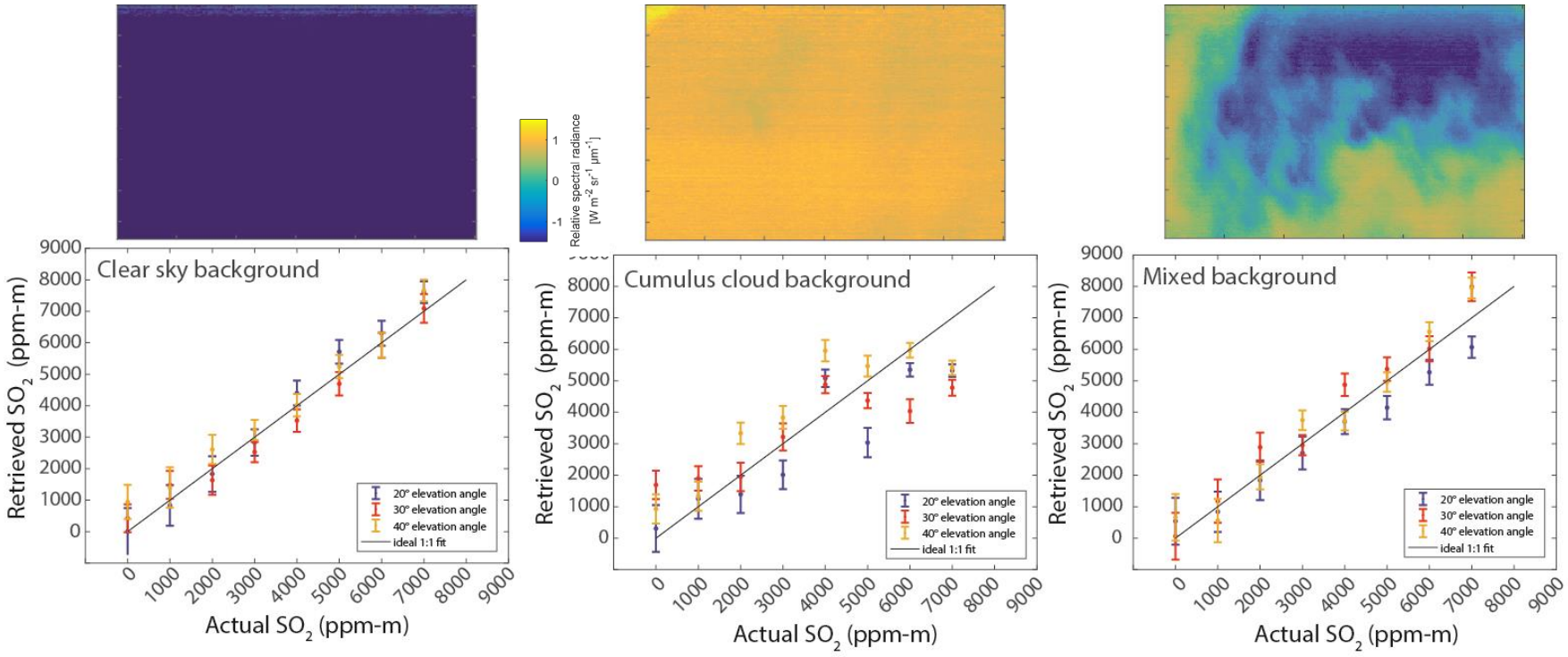


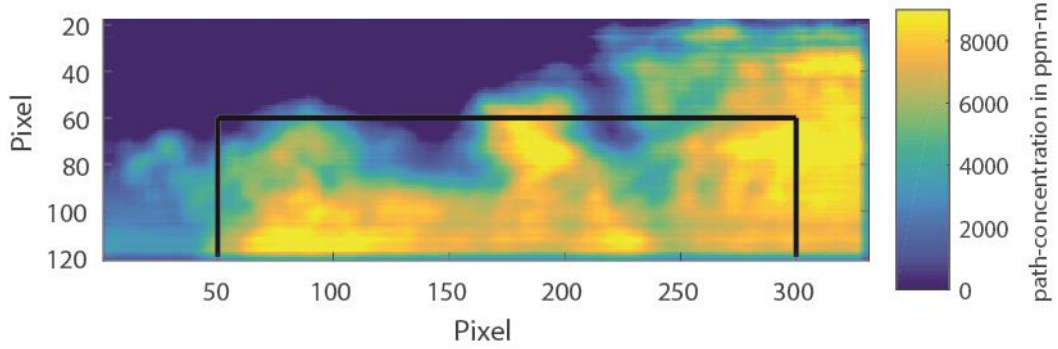
LWIR IMAGE DATA ALLOW ACCURATE AND PRECISE RETRIEVAL OF SO_2 PATH CONCENTRATIONS, QUICKLY



Rapid inversion of spectra to path concentration using a PLSR technique,suitable for application on IPM?

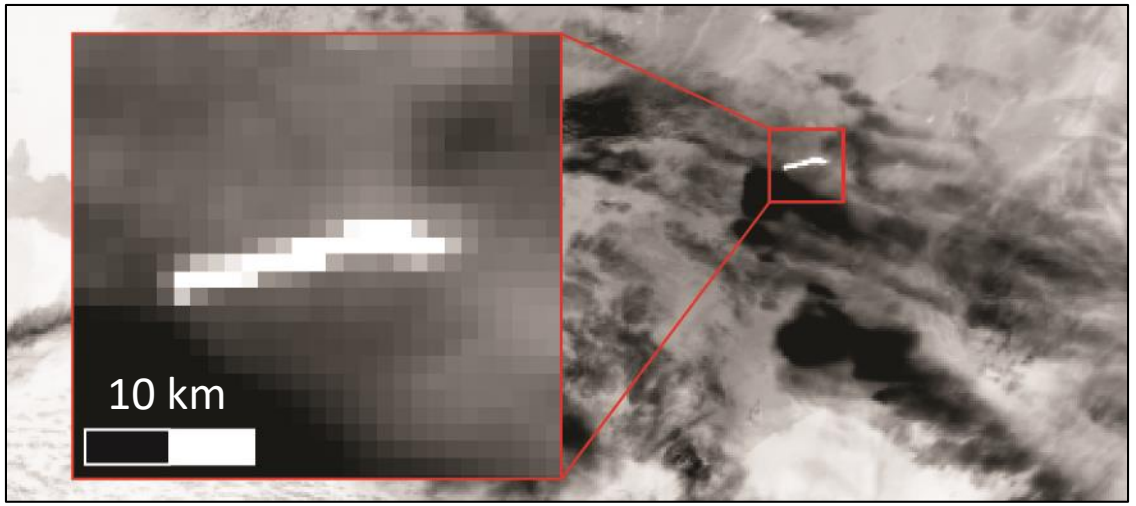


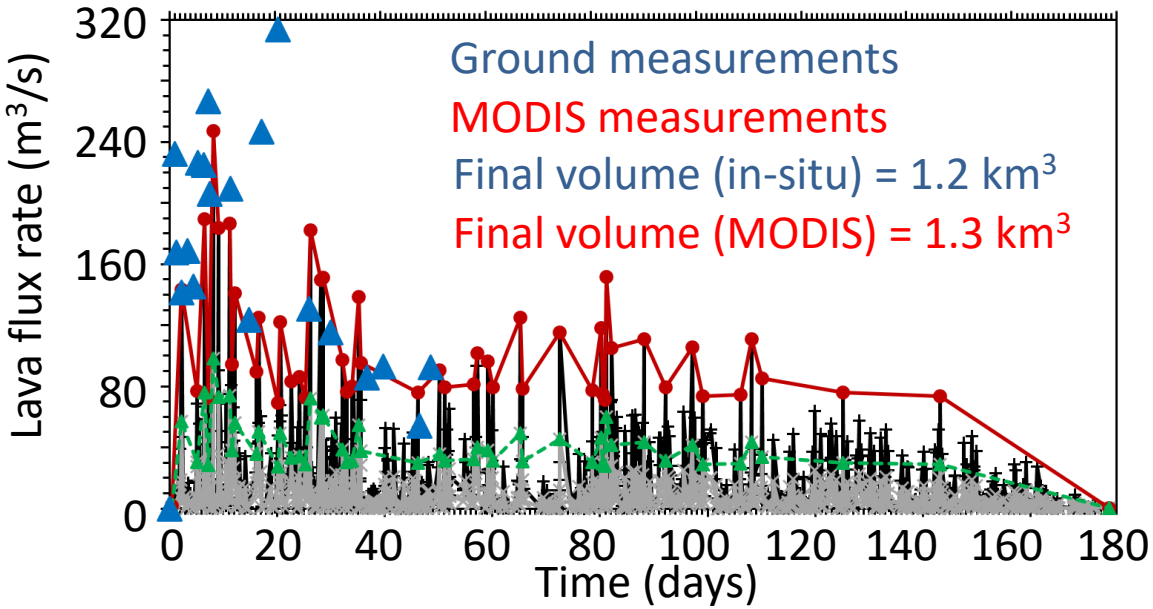




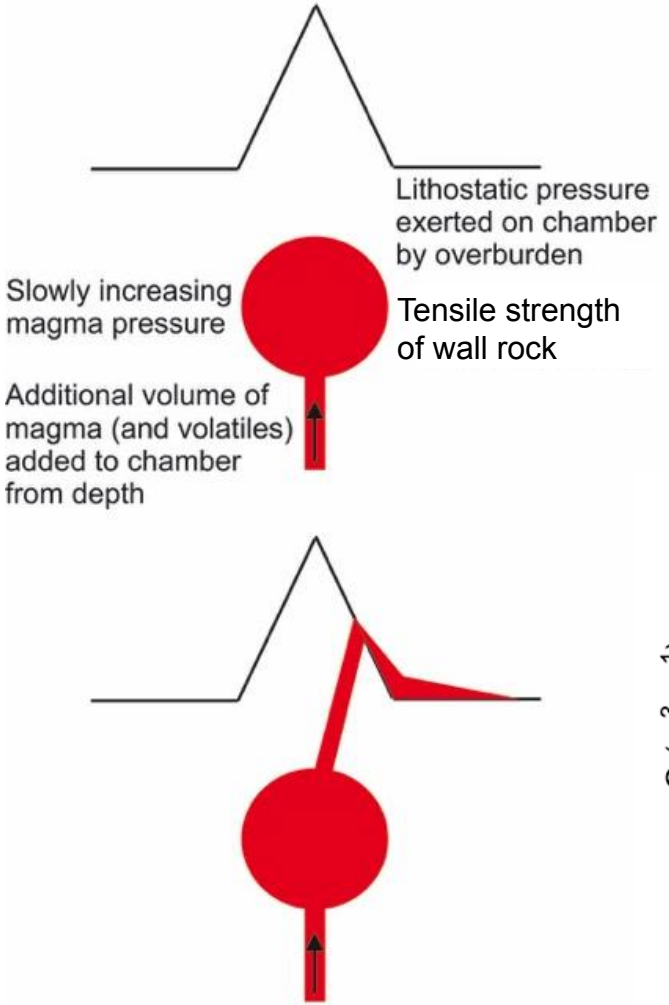
During Lava flow forming eruptions, effusion rate is a *crucially important parameter* to estimate in as timely a manner as possible

Estelle Bonny et al., (in review)

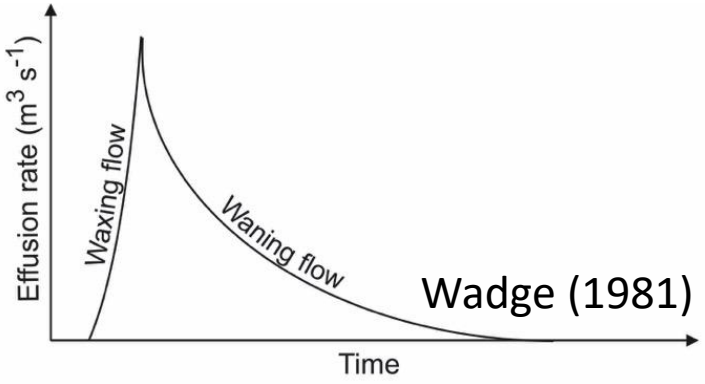




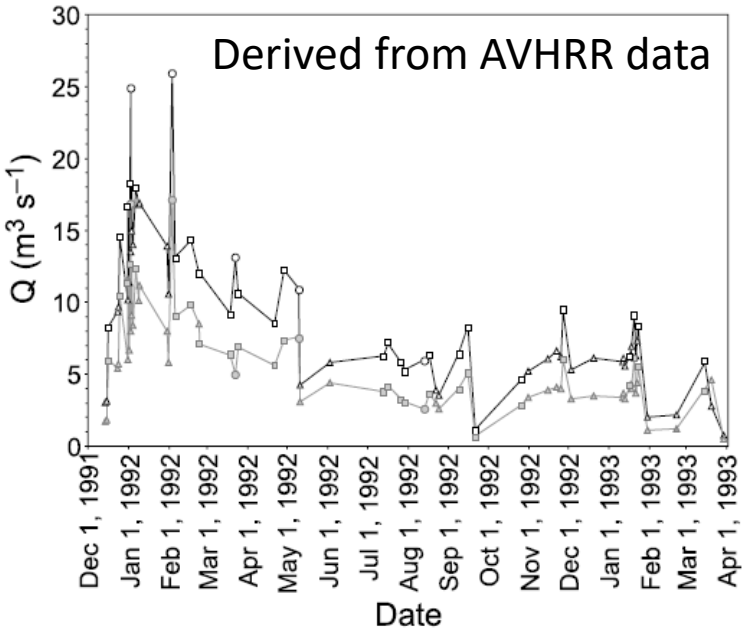
EFFUSION RATE IS AN IMPORTANT INPUT INTO DETERMINISTIC MODELS OF VOLCANIC BEHAVIOR, AND ALLOWS LAVA FLOW HAZARDS TO BE FORECAST

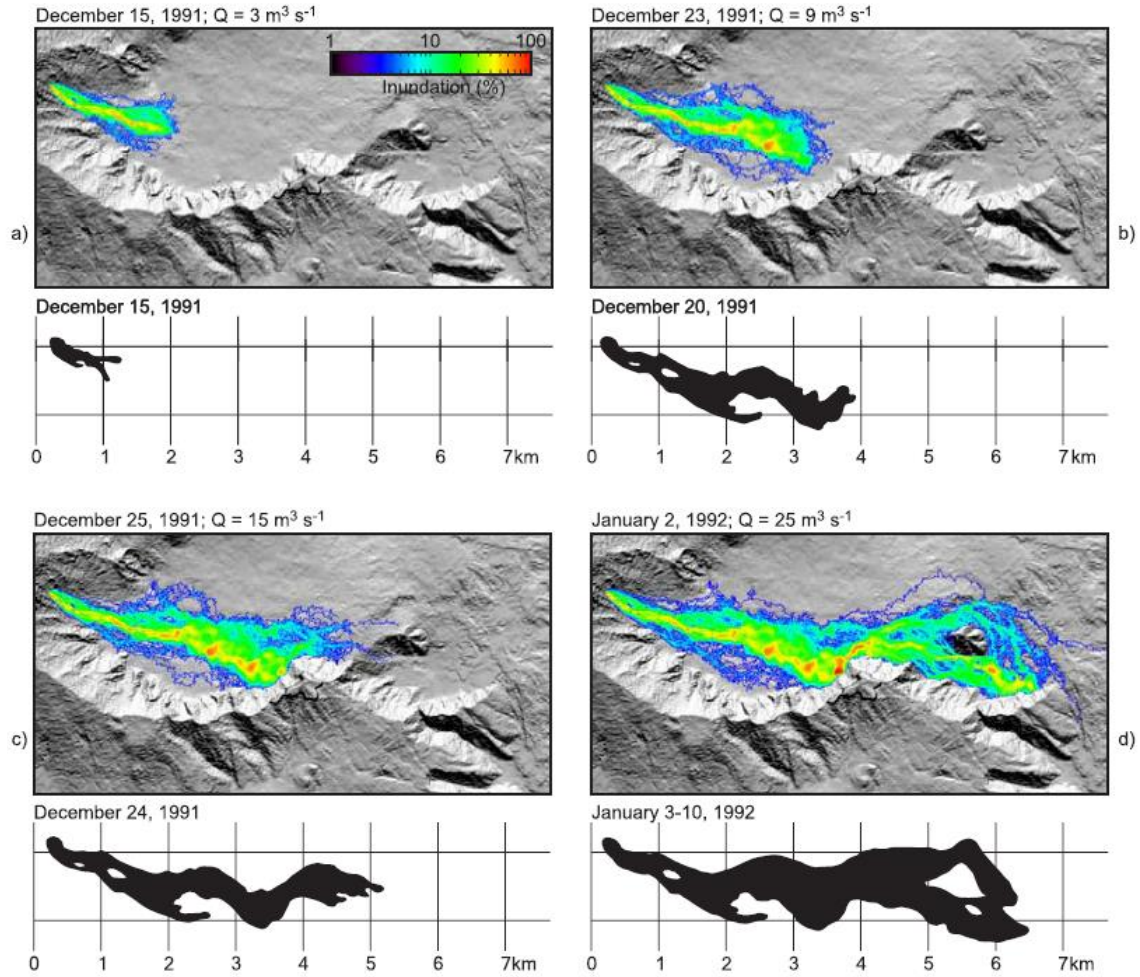


Blake (1981)



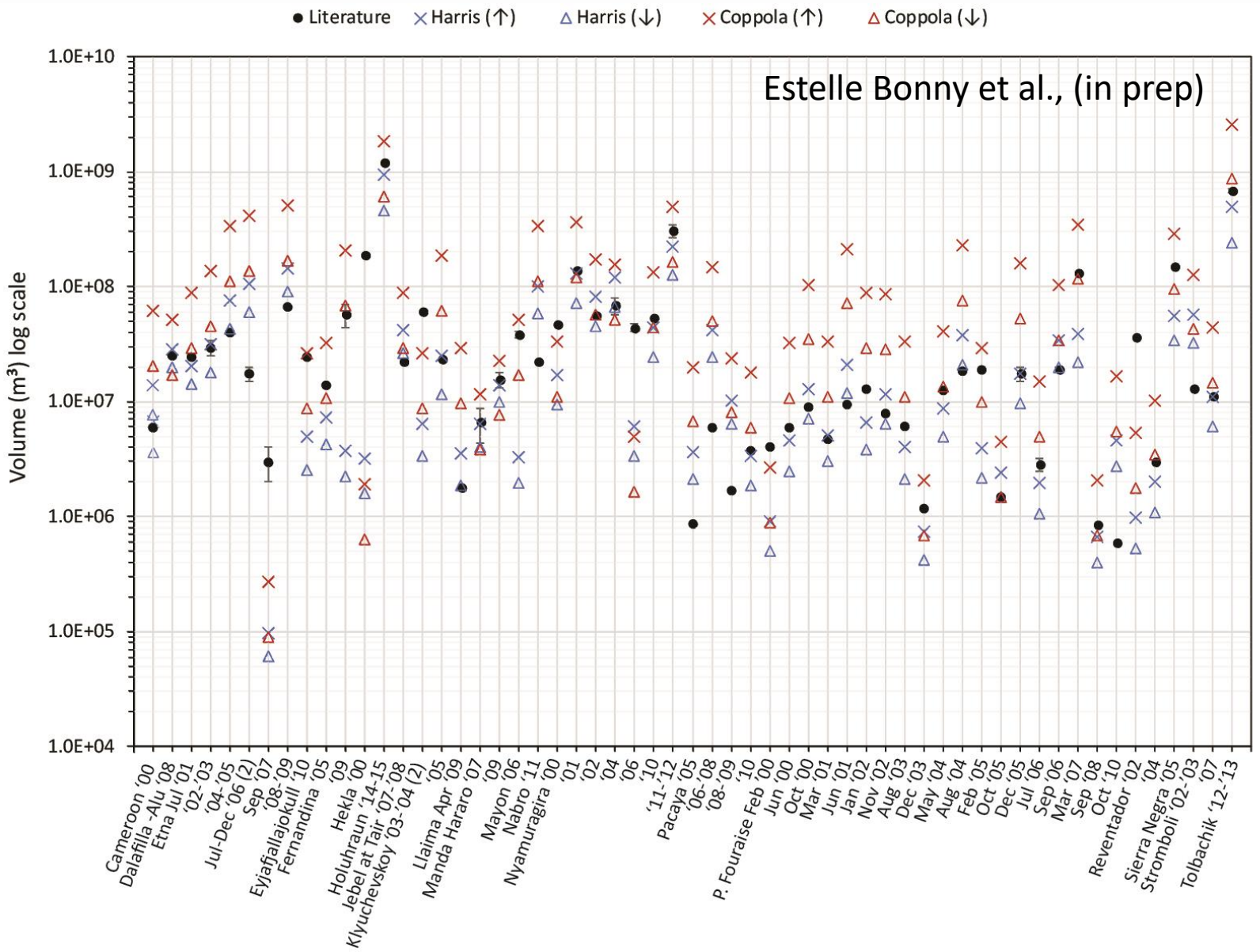
Wadge (1981)

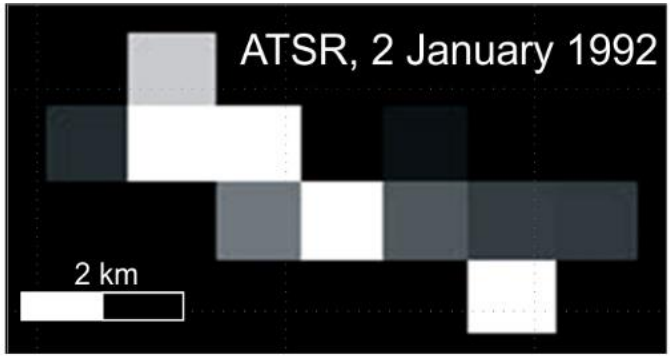




Wright et al. (2008)

LOW RESOLUTION INFRARED DATA ALLOW EFFUSION RATE TO BE ESTIMATED, BUT HIGH RESOLUTION HYSPIRI DATA WILL REDUCE THE ASSOCIATED UNCERTAINTIES

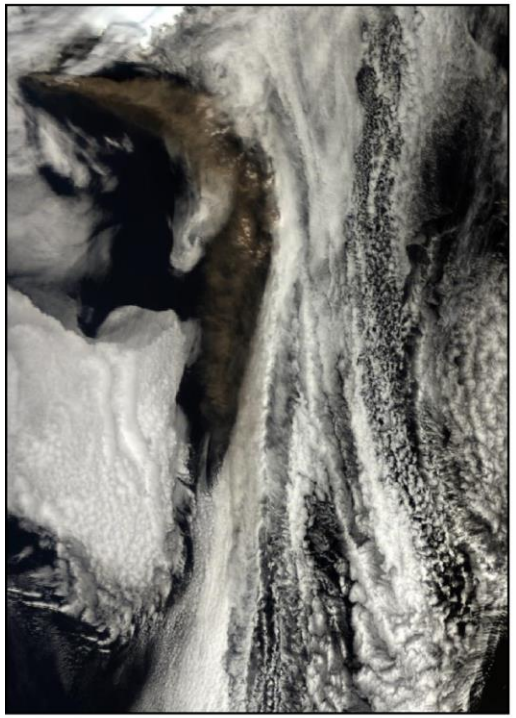


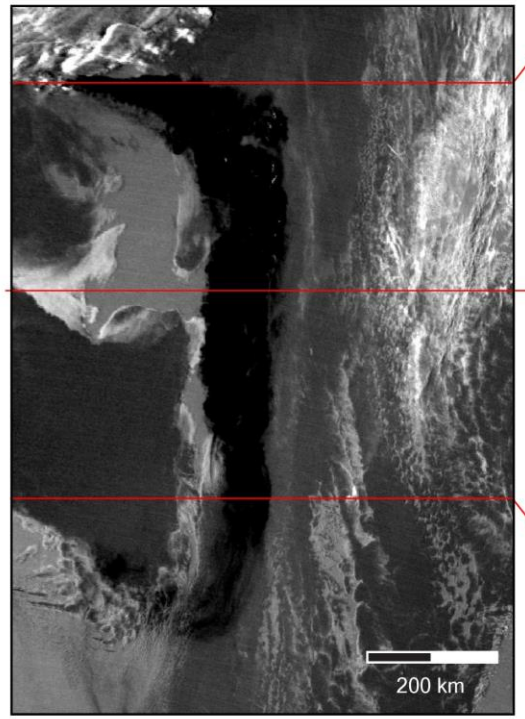


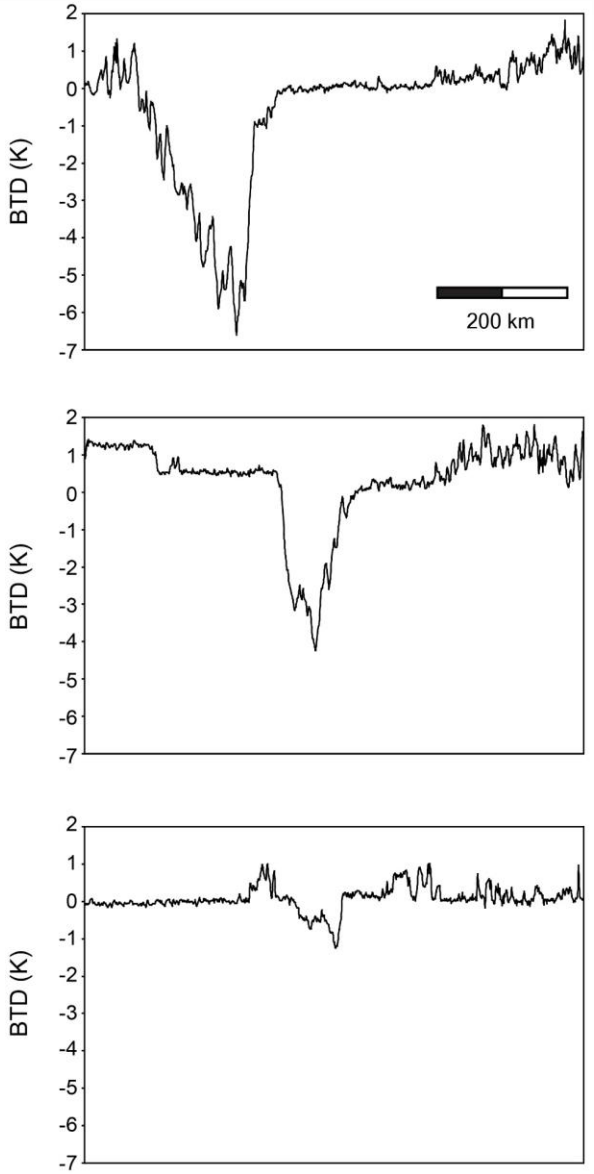
If effusion rate is proportional to area, then what is the area?

HYSPIRI WILL PROVIDE ESSENTIAL CALIBRATION FOR LOW RESOLUTION ASH CLOUD DETECTION SYSTEMS

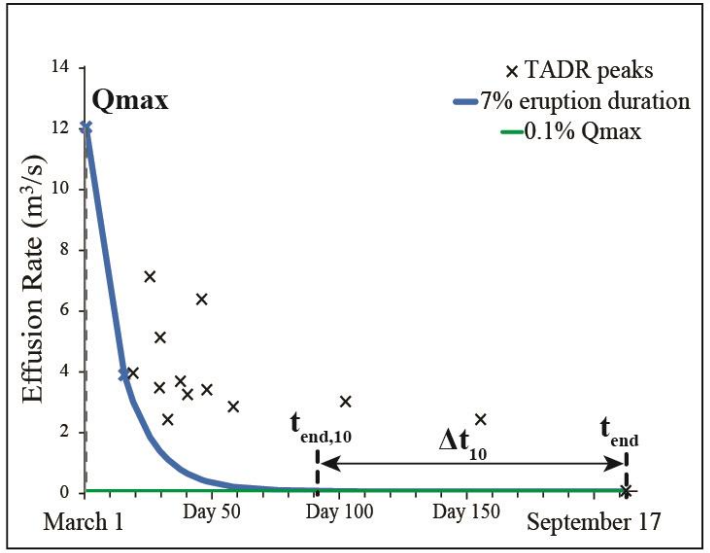
Volcanic ash clouds are a severe threat to global aviation. During an eruption, where is the 2 mg/m^3 “safe” ash concentration threshold exceeded?

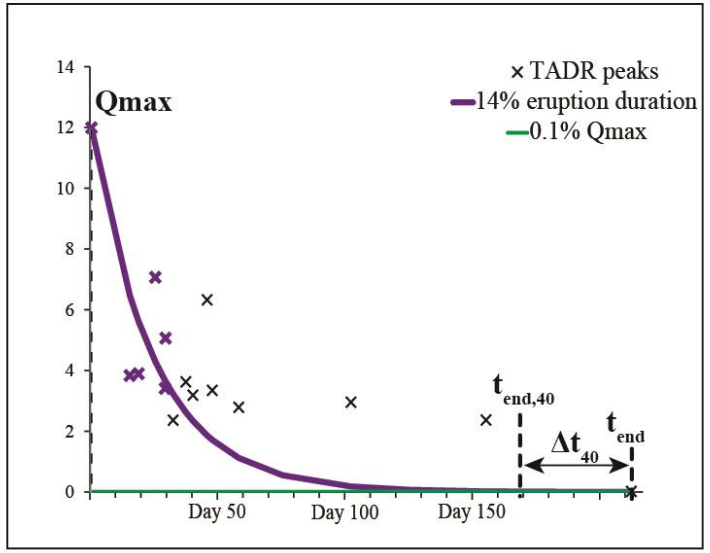


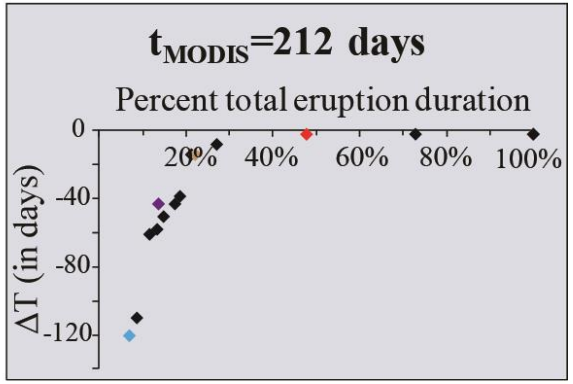


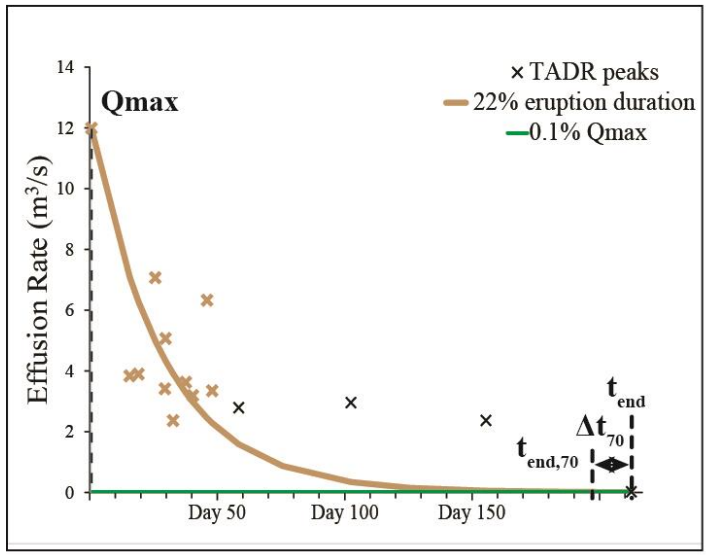


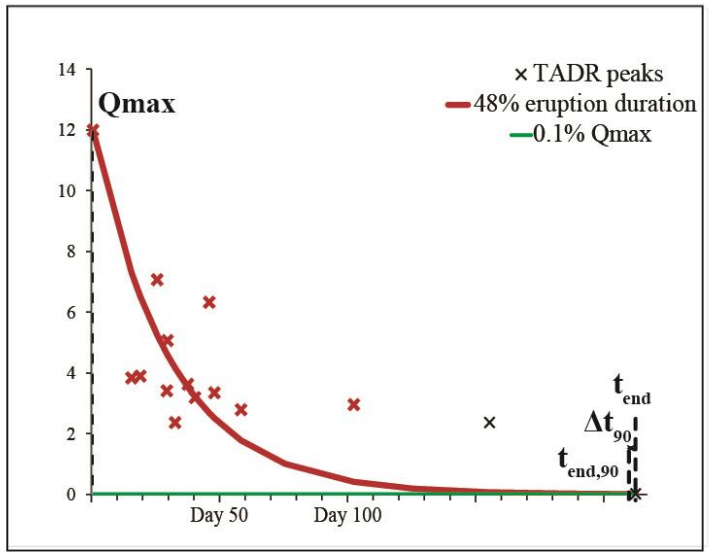
PREDICTING WHEN ERUPTIONS WILL END FROM SPACE – A CRUCIAL CONTRIBUTION TO REDUCING THE UNCERTAINTIES ASSOCIATED WITH ERUPTIONS.





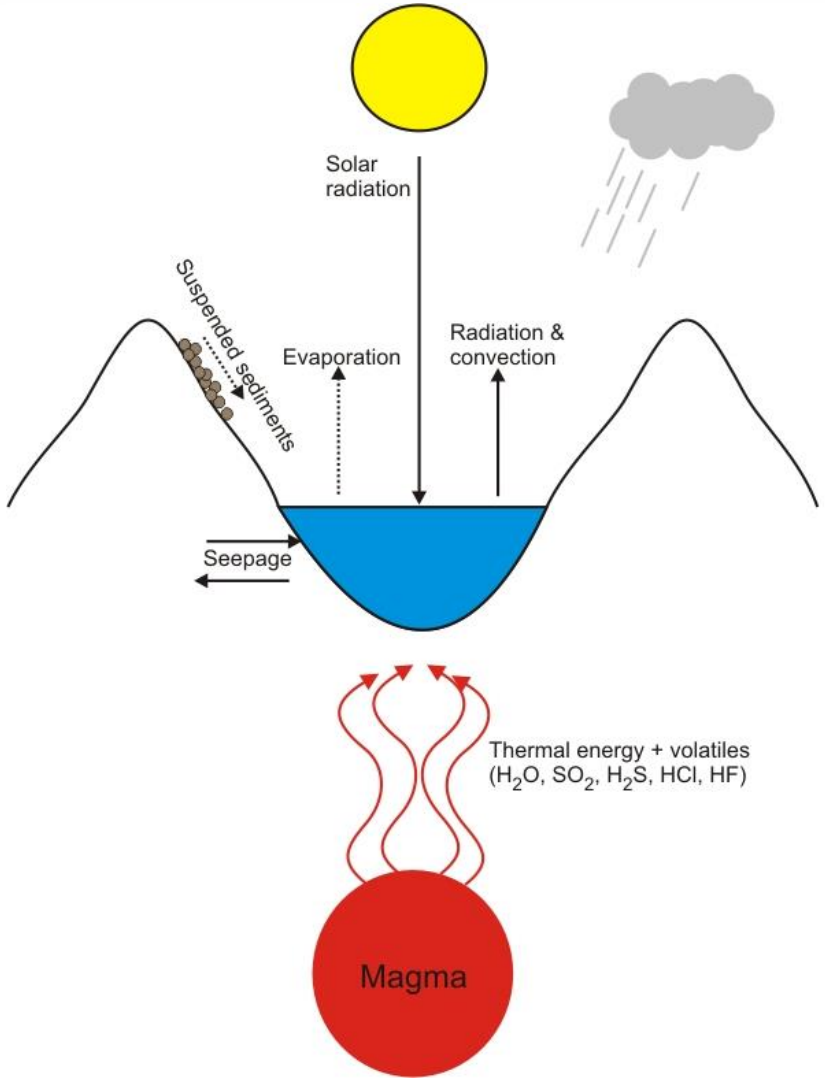


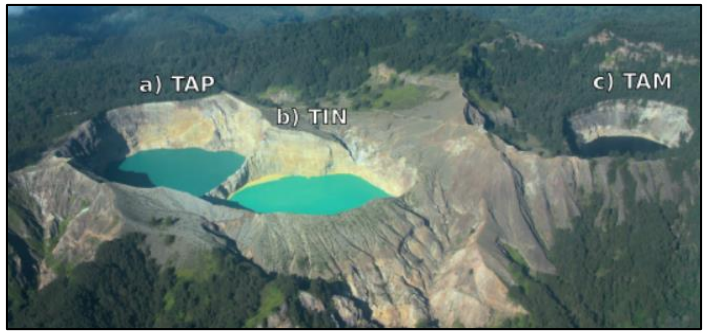


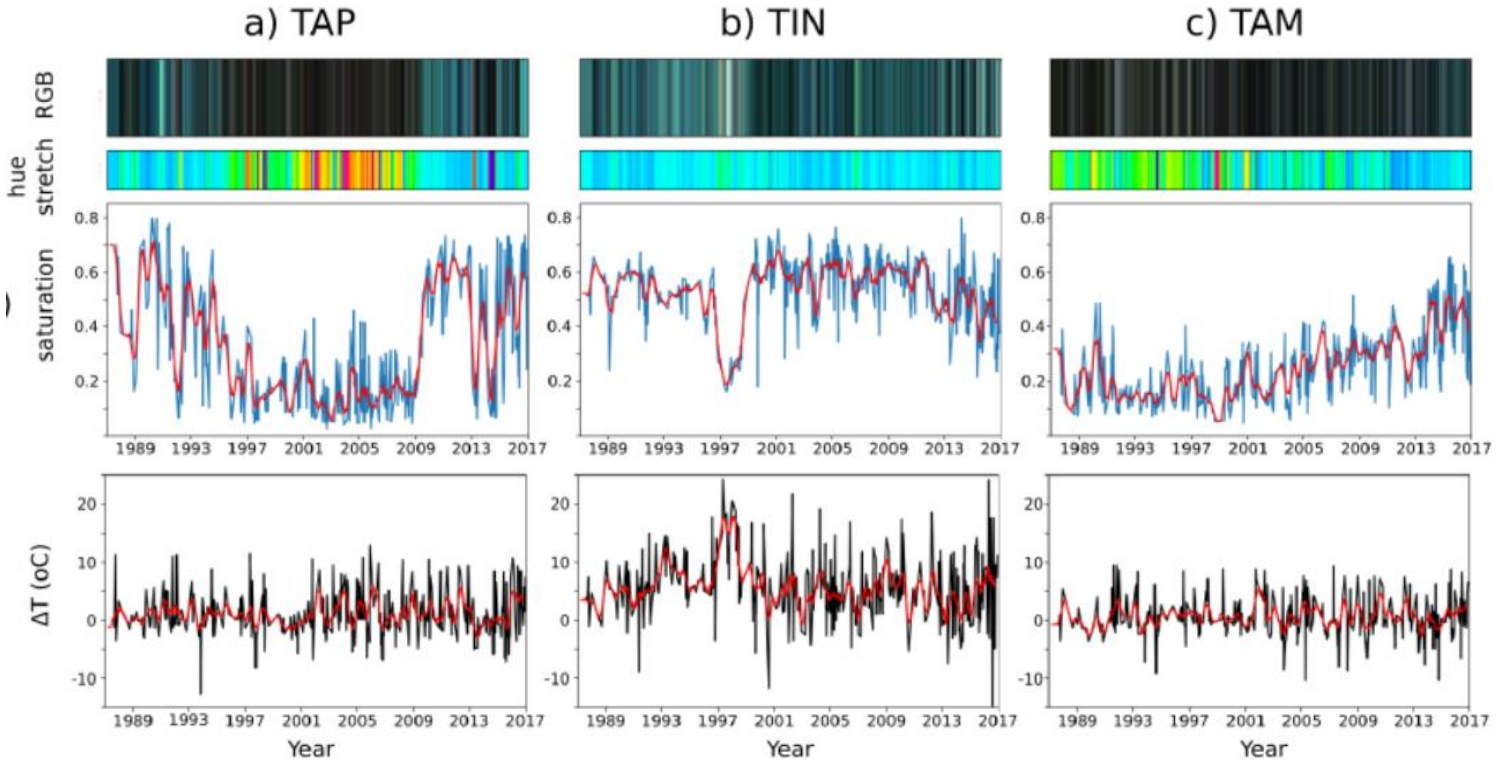


Bonny, E., and Wright, R. (2017)

CAN CHANGES IN THE COLOR AND TEMPERATURE OF VOLCANIC CRATER LAKES BE USED TO WARN OF IMPENDING ERUPTIONS?

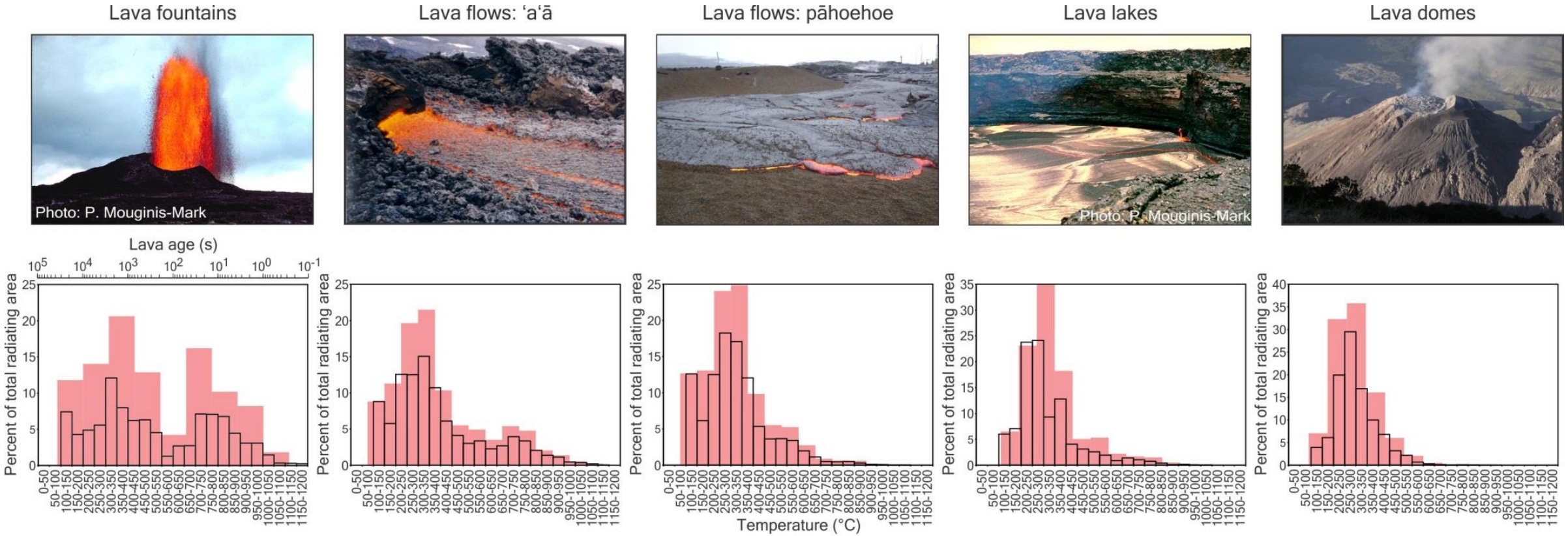






Murphy et al., (in press)

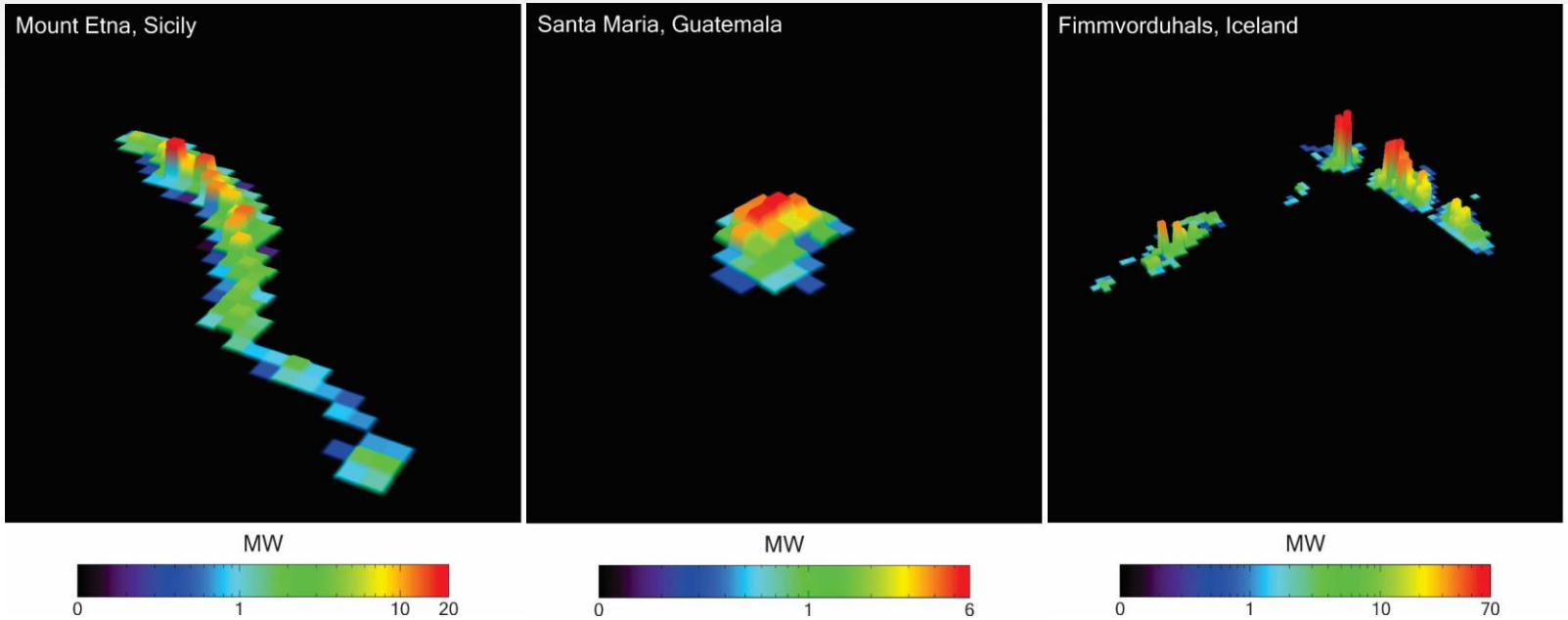
HYSPIRI WILL ALLOW US TO ACCURATELY DETERMINE THE SURFACE TEMPERATURE OF ACTIVE LAVA FLOW, DOMES, AND LAKES

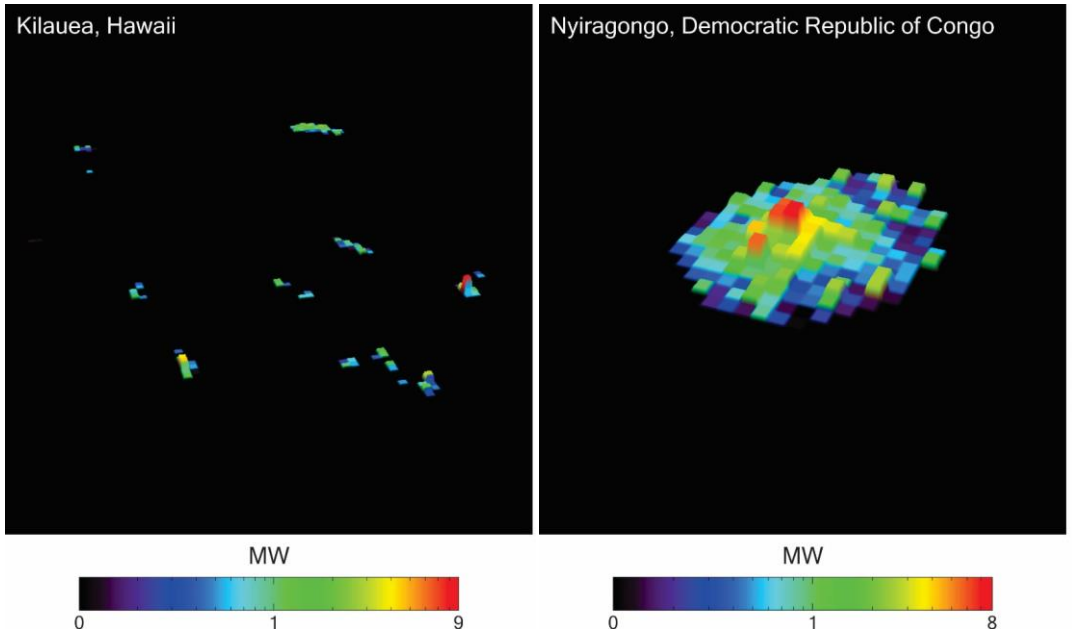


An imaging spectrometer always provides many unsaturated radiance measurements with which to perform the radiant-to-temperature inversion

Wright et al., (2011)

AND HENCE THE COOLING RATES OF ACTIVE LAVA FLOW, DOMES, AND LAKES

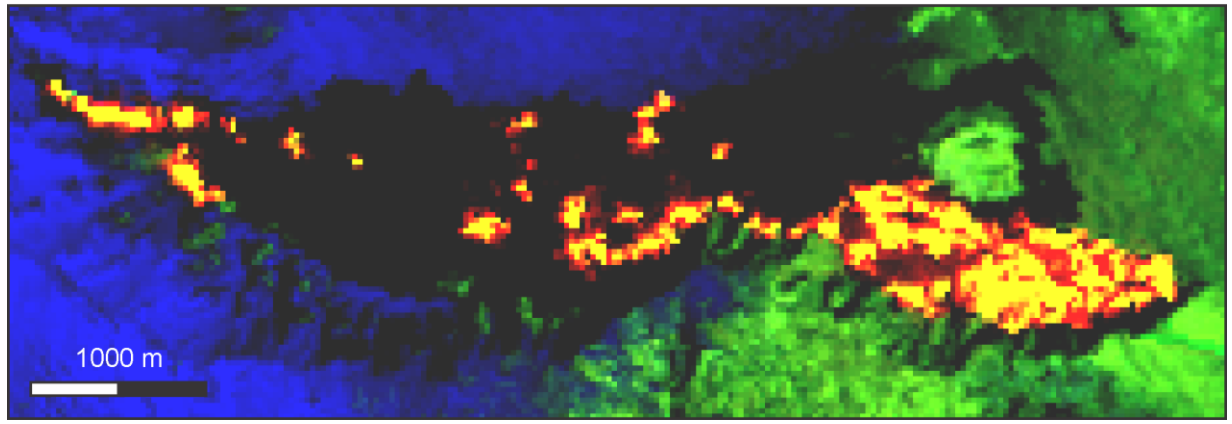


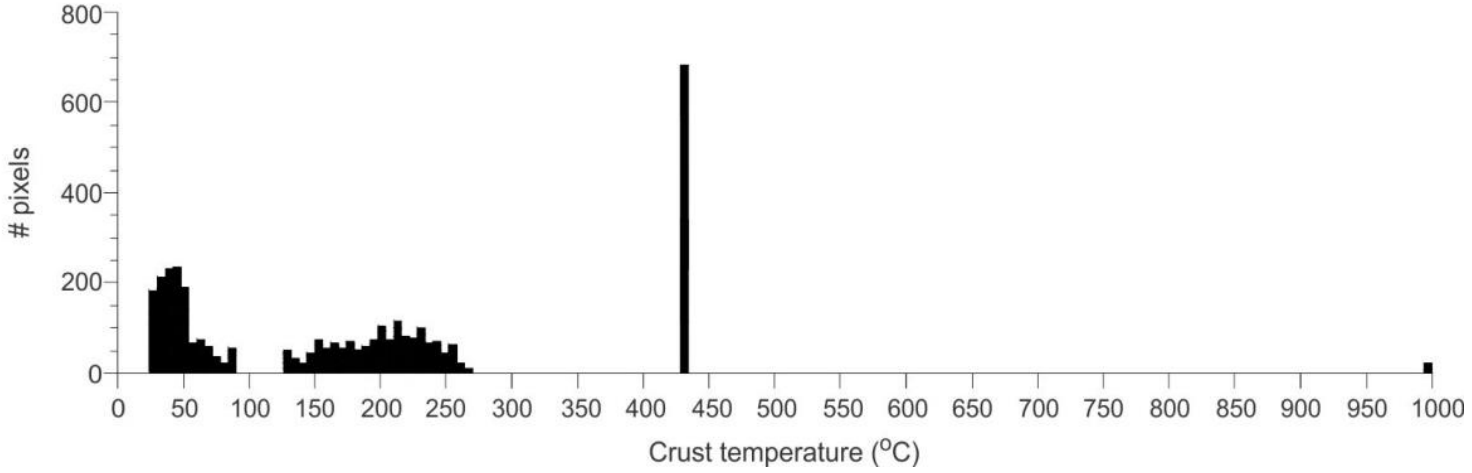


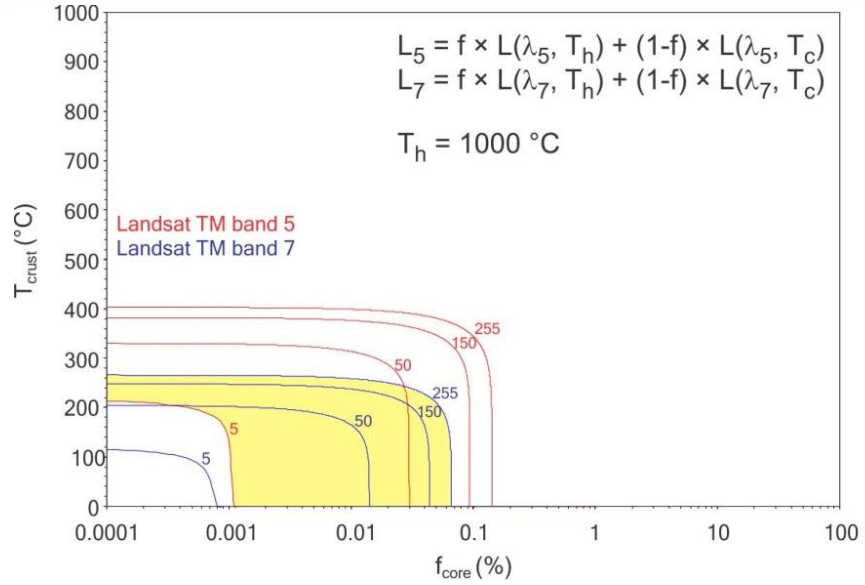
Cooling rate is a key control on lava rheology

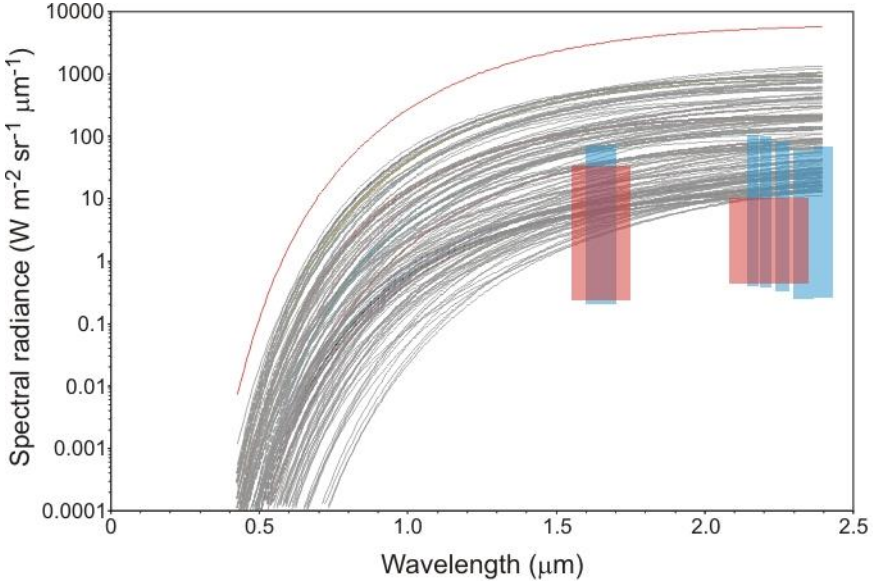
Wright et al., (2010)

THIS CANNOT BE DONE USING MULTI-SPECTRAL LANDSAT TM (OR ASTER) DATA

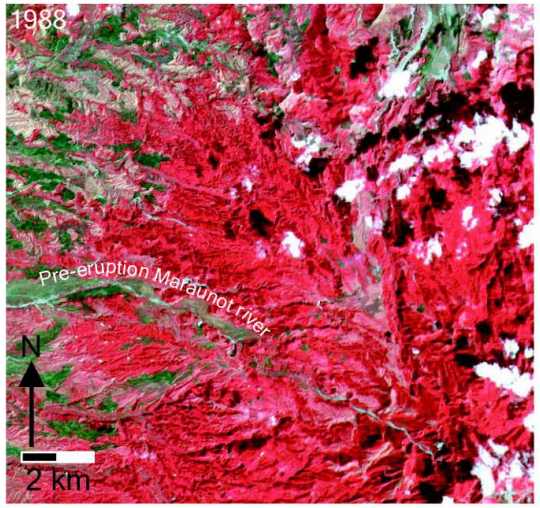


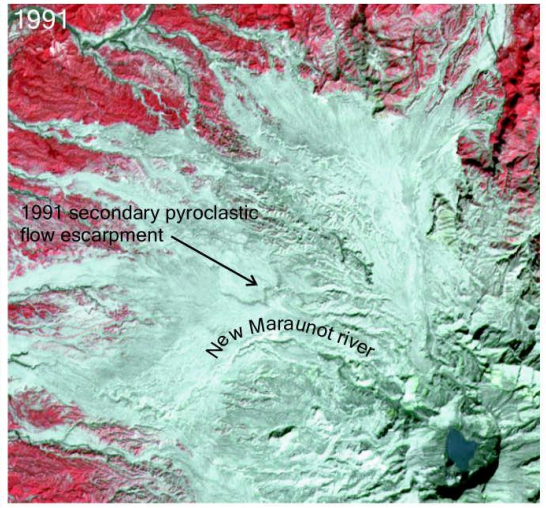


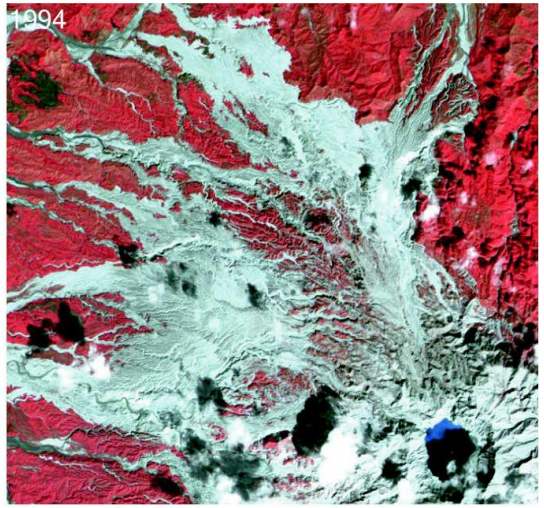


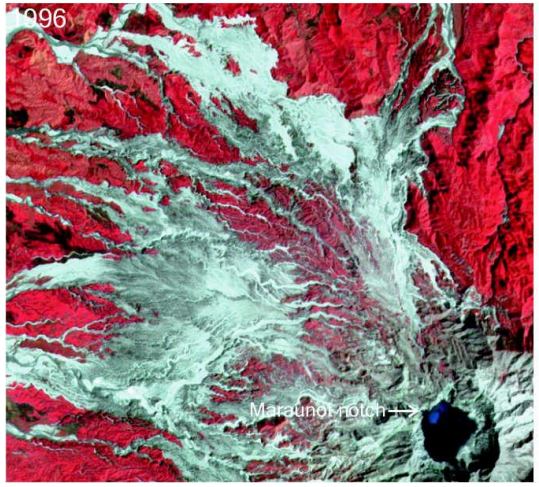


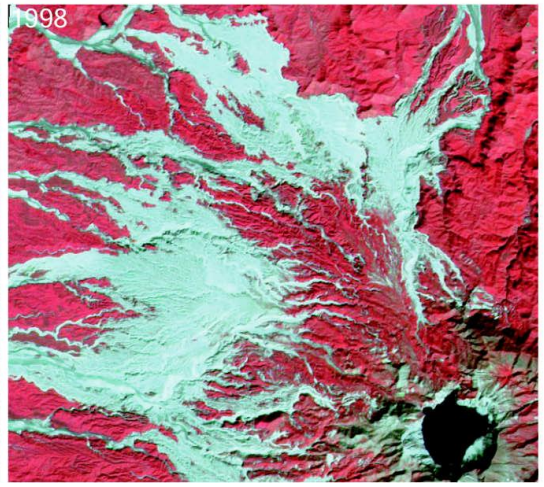
HYSPIRI WILL BE ABLE TO QUANTIFY THE IMPACT OF ERUPTIONS ON THE LANDSCAPE

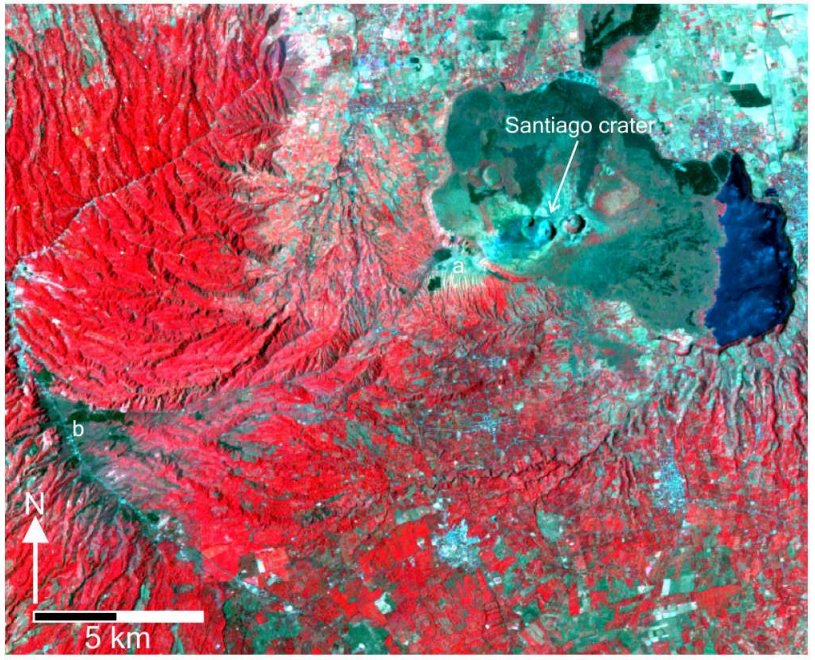


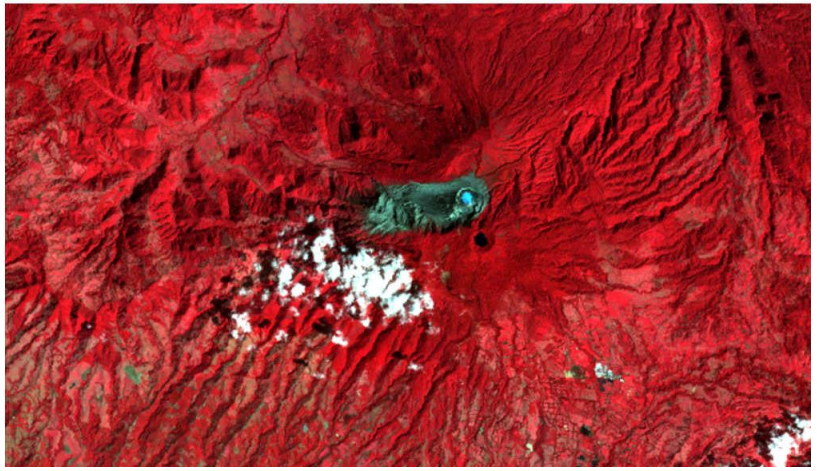


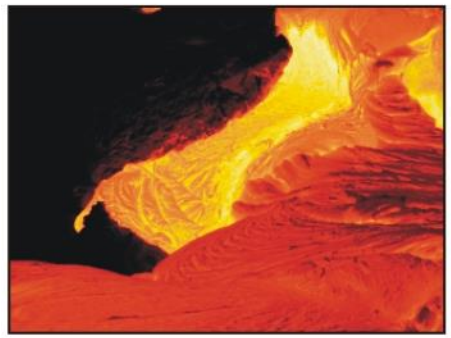


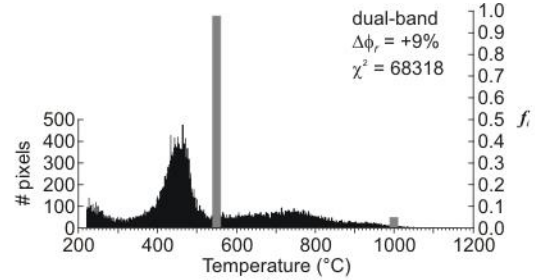


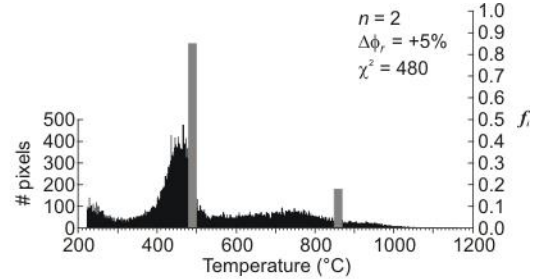


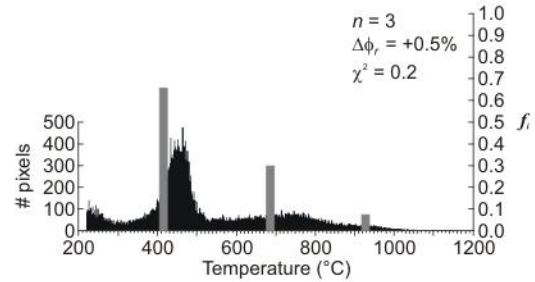


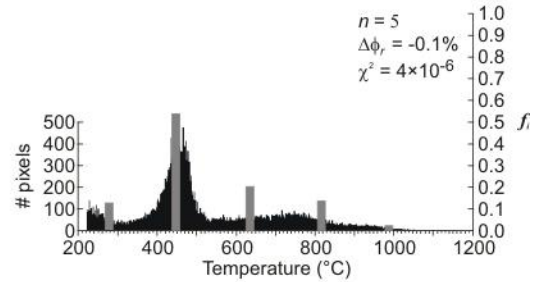












Wright and Flynn, 2003